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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/069,668	04/29/1998	KIE Y. AHN	303.466US1	3628

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EXAMINER

COLEMAN, WILLIAM D

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 03/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/069,668

Applicant(s)

AHN ET AL.

Examiner

W. David Coleman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 December 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 and 32-41 is/are pending in the application.
- 4a) Of the above claim(s) 29 and 30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 and 32-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. Applicants amendment filed December 2, 2002 in paper no. 24 is not persuasive.
2. Applicants contend that the 35 U.S.C. § 112, second paragraph should be withdrawn because Applicants believe that the scope of the present invention is independent of when, where or how the metal is introduced into the act of cross-diffusion.
3. In response to Applicants contention that the invention is independent of a when, where or how the metal is introduced for the act of cross-diffusion, the claims are directed to a process of forming a layer in which two materials are mixed (i.e. polysilicon and a metal). Accordingly, since Applicants are claiming a process it is deemed that the presence of a metal is very important to the process. Please note that the term “substituting” in the claim is interpreted as physically replacing an item or element with something else. The term “cross-diffusion” implies that at least two items or elements where there to begin with in the first place.
4. Applicants contend that regarding claims 1, 4, 5, 12, 20, 23, 32, 43 and 34 fails to set forth a prima facie case of obviousness. Specifically, Applicants contend that the combination of Tsai U.S. Patent 5,235,204 in view of Wolf “Silicon Processing for the VLSI Era”, vol. 2 does not result in the combination of teaching “cross-diffuse metal and polysilicon to produce a metal emitter contact. Applicant further limits his argument to pp 126 of Wolf.
5. In response to Applicants contention that the combined references fail to teach cross-diffusing metal and polysilicon to produce a metal emitter contact, Applicants are directed to pp 127 of Wolf. Wolf teaches forming a thin sacrificial polysilicon layer in FIG. 3-28. In response to applicant's argument that there is no suggestion to combine the references, the examiner

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recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the thin polysilicon sacrificial layer will protect the junction underneath as taught by Wolf.

6. Applicants contend that Claim 18 requires “heating at least the deposited metal and the polysilicon structure to urge diffusion of the deposited metal into the polysilicon layer.

7. In response to Applicants contention that the combined teachings fail to disclose the term “heating”, please note that “annealing” is an equivalent term for heating. Applicants are directed to page 127, second paragraph of Wolf, where the term “anneal” is used near a temperature of 450°C.

8. Applicants further contend that Claim 28 is allowable because Applicants use the term “cross-diffusion”. This argument is addressed above.

9. Applicants further argue that incorporating metal into polysilicon does not change the resistance of the material. These arguments are noted, however, polysilicon is a semiconductor material and metal has a different conductivity as compared to a semiconductor and the mixing of the two will ultimately change the resistance of both materials.

10. Applicants have noted that there is no art rejection of claim 34.

In response to Applicants notation, please note that claim 34 was objected to, but because claim 34 depends on 32, which was rejected under an art rejection and 35 U.S.C. 112, claim 34 is also rejected under 35 U.S.C. 112 second paragraph.

Claim Rejections - 35 USC § 112

11. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

12. Claims 1-28 and 32-39 recites the limitation "metal" in independent claims 1, 4, 6, 12, 18, 20, 23, 28, 32, 33 and 35. There is insufficient antecedent basis for this limitation in the claim. Correction is required. Prior to the amendment filed February 21, 2001, Applicants used the term "substituting metal for at least a portion of the polysilicon structure", which is clear and there is no ambiguity. Applicant's amendment filed on or after February 21, 2001, Applicant's amended claim was changed to "cross-diffusing a metal for at least a polysilicon portion". The Examiner's position is that to cross-diffuse a metal for at least the polysilicon portion, a metal must be deposited or formed prior to cross-diffusion.

13. Applicants have not provided a reasonable disclosure to provide for such a process step, i.e., the metal must be provided before it can be cross-diffused. Applicants claim to substantially replace a portion of the polysilicon with aluminum and after cross-diffusing produce a metal emitter entirely above the surface of the substrate at the emitter region. Please note that there is a metal layer above the surface of the substrate at the emitter region position in the Tsai teachings. According to the conventional Laws of Physics, matter is neither created nor destroyed, however, Applicants are implying that cross-diffusing aluminum will substantially replace polysilicon. This would be reasonable if Applicant's provided a specific amount of polysilicon material and a specific amount of aluminum which would be more than the polysilicon layer and decided to

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form aluminum contacts alloyed with a small amount of silicon. However, as the interpreted by what is written in the claims and disclosed in the Application, Applicant does not have support for substantially substituting all of the polysilicon for aluminum as claimed.

14. Correction is required.

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 28, 32, 33, 35, 36, 37, 38, 39, 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsai, U.S. Patent 5,235,204 in view of Wolf, "Silicon Processing For The VLSI ERA", vol. 2 (Process Integration), Lattice Press, 1990, pp. 116-117 & 126-127.

17. Pertaining to claims, 1, 4, 5, 7, 8, 9, 10, 28, 35, 36, 37, 38, 39, 40 and 41, Tsai discloses a semiconductor process substantially as claimed. See **FIG. 6**, where a method of making an emitter contact for an emitter region of a bipolar transistor is disclosed. Tsai discloses a polysilicon structure **60** over an emitter region position of a semiconductive substrate (not numbered). However, the metal emitter contact is not formed by cross diffusing the metal and a portion of the polysilicon structure. Wolf teaches the use of a doped polysilicon sacrificial barrier in the fabrication of contacts and interconnects (pp. 126). A thin layer of doped polysilicon can be used to separate the Al and the single-crystal Si substrate (Fig. 3-28). After the Al:Si alloy film as been patterned, the contact structure is annealed (pp.127). In view of

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Wolf, it would have been obvious to one of ordinary skill in the art to form the metal emitter contact of Tsai by cross diffusing the metal and a portion of the polysilicon structure, because this process alleviates the problem of junction spiking (pp. 116).

18. Pertaining to claim 2, Tsai discloses an emitter region **40** as seen in **FIG. 6**. However, in the absence of new or unexpected results, the mere reversal of the order of performing process steps has been held to be prima facie obvious. In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946).

19. Pertaining to claim 3, Tsai discloses that the emitter region 40 is polysilicon and metallurgy level being aluminum, which is obviously a doped layer (p-type) that will outdiffuse into the polysilicon region when annealed.

20. Pertaining to claim 11, Tsai discloses that the metal layer 64, can be aluminum. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tsai, U.S. Patent 5,235,204 in view of Wolf, "Silicon Processing For The VLSI ERA", vol. 2 (Process Integration), Lattice Press, 1990, pp. 116-117 & 126-127, as applied to claims 1-3 and 7-11 above, and further in view of Aboelfotoh et al., U.S. Patent 5,801,444.

21. The combined teachings of Tsai in view of Wolf discloses a semiconductor process substantially as claimed as discussed above. However the combined teachings fail to disclose a polysilicon layer that includes polysilicon and germanium. Aboelfotoh discloses a semiconductor process wherein germanium is included with silicon for the purpose of making electrical contacts. See **FIG. 11** of Aboelfotoh, where germanium (11) is deposited with polysilicon for the purposes of a contact for a semiconductor device. In view of Aboelfotoh it

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would have been obvious to one of ordinary skill in the art to include germanium with polysilicon for contact formation because a substantial advantage to be gained is that electrically stable contact metallization (column 5, lines 49-51).

Conclusion

22. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

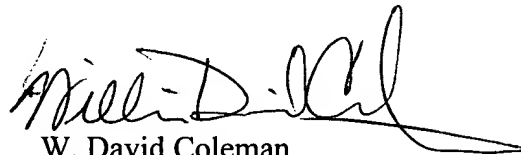
23. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

24. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 703-305-0004. The examiner can normally be reached on 9:00 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7721 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

A handwritten signature in black ink, appearing to read "W. David Coleman", with a long horizontal flourish extending to the right.

W. David Coleman

Examiner

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WDC

March 26, 2003